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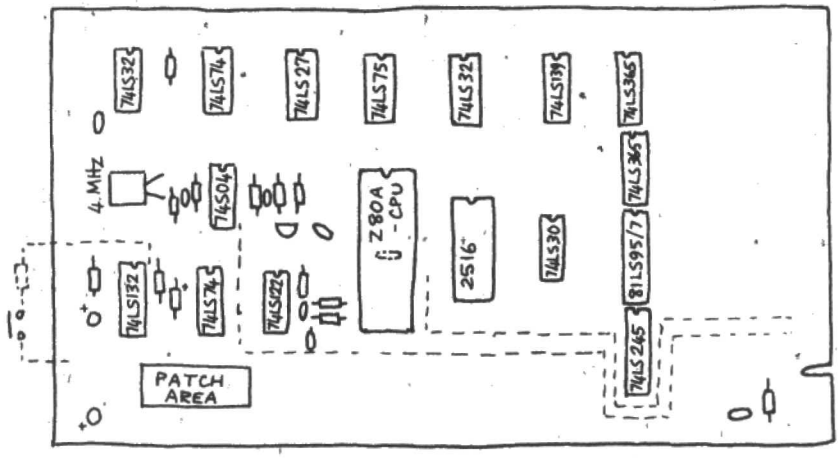
Interak 1

MZB-3 CPU CARD

Z80A CPU with on board EPROM Socket



MZB-3 Z80A 4MHz CPU Card

FEATURES

* International Size Card (4.5" x 8").
* Fast Z80A CPU runs at full 4MHz.
* Quartz crystal controlled.
* Address and data lines fully buffered (four buffer chips).
* Power on reset, and manual reset.
* Reset line pulsed to maintain Dynamic RAM data when reset is active.
* Z80A Refreshes Dynamic RAMs transparently.
* On-board 4-bit address latch included for easy interface to Dynamic RAMs.
* On-board "boot" EPROM socket, addressable at any 4K boundary.
* Boot EPROM can be disabled under software control.
* Power-on jump circuit to any 4K boundary.
* Epoxy-glass PCB
* Double-sided board, tinned copper tracks.
* Gold-plated edge connector on A side.
* Needs only single 5V rail (if 5V on- board EPROM is used).
* ISBUS-A, INTERAK 1, KBUS-12 bus compatible (some slight modifications required)
* KBUS-5 compatible.
* 28-pin 0.3" DIL patch area provided, for user's own purposes.

DESCRIPTION

The MZB-3 is a "Kemitron" card which has been selected for use in the INTERAK 1 computer, as it is ideally suited for this purpose.

Bus Allocations

The "Kemitron" allocation for the NWAIT line on the card is position A30, and this needs re-routing to position A34 to suit ISBUS-A and INTERAK 1. See the data on the "ISBUS 1.1" for further details of the INTERAK 1 bus.

The CPU card is the heart of a computer system (or perhaps more correctly the "brain"). The Z80A is an ideal choice since it is rapidly becoming the standard 8-bit microprocessor. (This is proved by observing that many 6502-based computers now provide "add-on" Z80A adaptors; you never see an add-on 6502 for a Z80A-based computer.)

Crystal Controlled

The Z80A is a specially selected fast version of the standard Z80, and is used on this card at its full 4 MHz operating speed. No "Wait" states are included to slow the CPU down, but the NWAIT line on the bus is available for use with slow memories. Note that the VDU-K and the MXD-2 Dynamic RAM cards do not require any wait states, and so the CPU card in an INTERAK 1 system can operate at its full speed.

The "clock" signal required for the Z80A is not a normal LSTTL level, but is required to swing right up to +5V. At full speed an "active pull-up" is needed to meet this requirement, and is included on the MZB-3 card. A separate clock of the same frequency is output to the bus for those cards which require it.

Reset

A power-on reset circuit is included as standard, so that the system starts to operate in an orderly manner. A push-button switch is provided so that the user can reset the system at any time, without the need to sacrifice the contents of memory by switching the computer off. The reset signal is taken to the bus, so that any other cards which require resetting can be reset at the same time.

Dynamic RAM

As the user can reset the CPU at any time special circuitry is needed, and is included on the card, to ensure that the reset pulse does not occur in the middle of a Dynamic RAM access, and so corrupt any data stored. As Dynamic RAM needs "refreshing" several hundred times a second, and this is carried out by the CPU, it is important that the reset pulse is not maintained for too long a time. The reset circuitry on the MZB-3 card ensures that this requirement is met also.

Although the Z80A has been chosen primarily because it is the best and most well-known microprocessor, a very useful built in feature it possesses, which is not built into other microprocessors such as the 6502, is its ability to refresh Dynamic RAM "transparently". More will be said on the subject of refreshing, why it is needed and so on, on the MXD-2 card data sheet, but there are some aspects which are most conveniently covered here.

The built in Z80A refresh is described as "transparent" because it is carried out at a time when the Z80A is not using the bus, and so does not slow the Z80A down in any way. The particular time used is available after each "op-code fetch"; this is when the next instruction of the program has been fetched and is being decoded by the Z80A. Special hardware within the Z80A chip outputs the necessary refresh signal at this time, without the rest of the CPU being involved at all.

A special 4-bit latch has to be added to the CPU circuit, to feed the top four address lines when Dynamic RAMs are being used, and of course this is included on the standard MZB-3 card.

Buffers

Buffers are needed in a computer system to allow each card to drive the bus with sufficient power so that neither corruption of data nor damage to expensive integrated circuits will occur. It becomes doubly important when the CPU is being run at top speed, so that the signals can reach their full voltage levels in the short times available.

Beware of systems where the buffering is omitted simply to give a low price "starter kit", or to cram too much circuitry on the introductory card in the system.

Power on Jump

An important feature of INTERAK 1 is that it has RAM starting at location zero. There are many technical reasons why this apparent compexity is a good thing, and these are discussed in the various INTERAK 1 leaflets. Suffice it to say that the technique of having RAM at zero solves more problems than it causes. There is in fact very little benefit in a simple minimum system, but an expandable system like INTERAK 1 should have as few limits as possible placed on the future needs of the more advanced user (for example note that the well known disk operating system CP/M just will not work unless RAM is present from zero upwards).

At power-on, the RAM at zero will not usually contain any useful program and it is necessary to force the Z80A to "jump" to get its first instructions from some other address (usually one at which an EPROM is to be found). This address can be set by wire links to any 4K boundary, and in the INTERAK 1 system it has been chosen to be E000 (hexadecimal). One of the first tasks of the program at E000 is to disable the power-on jump circuitry. On the MZB-3 card this is carried out by the software inputting or "reading" any data from Port FF (hex.). The program which is located at E000 in an INTERAK 1 system is called ZYMON 2 (q.v.).

On-board EPROM

One of the uses of the MZB-3 card is in a floppy disk machine, with 64K or more of RAM, and a serial VDU terminal. In such a system all of the programs are stored on the disk and are run in RAM. However at power-on the RAM does not contain any useful programs, and a "boot EPROM" is needed to get the elements of the CP/M disk operating system from the disk into RAM. (The name "boot" EPROM is used to describe the process because it is a similar procedure to trying to lift yourself off the ground by your own bootstraps.)

Once the boot EPROM has done its work it is an embarrassment in a less sophisticated system than Interak 1 as it is taking up valuable memory space which could be used for other things.

In order to cater for the special requirements of the system described above, the MZB-3 has space for an "on-board EPROM". This is placed on the CPU side of the data line buffer, and addressed in a chosen 4K space. Whenever the Z80A addresses system memory in this 4K space, the data is presented to the data bus buffers on the MZB-3 card, in the normal way. However the buffer is not enabled, and instead the Z80A is forced to accept the data from the on-board EPROM. If the on-board EPROM contains a "bootstrap" program then once its work is done it can be switched out

altogether and the system memory will appear in the memory map at the 4K address. As with the power-on jump, control is by the software, and in this case takes effect when any data is output ("written") to Port FF.

It should be noted that the decoding on the MZB-3 Card devotes a whole 4K to the on-board EPROM, but this of course does not prevent smaller programs from being used, for example ZYMON 2, which is 2K in length, see below.

Special use of on-board EPROM

The INTERAK 1 system does not use the on-board EPROM to contain a "bootstrap" as described above. However it is very convenient to use the socket to contain the ZYMON 2 monitor program, to save the user the expense of purchasing a whole EPROM card when he is just starting. In this application the address is chosen to be the same as the power-on jump address, i.e. E000. As ZYMON 2 self-relocates to address zero, the on-board EPROM could be switched out; this action is not normally taken because there is nothing at E000 which is being displaced in an INTERAK 1 system.

A further benefit in locating ZYMON 2 on the MZB-3 card is that it will typically run without wait states, since there are no buffer delays to be suffered, as the on-board EPROM is on the Z80A side of the buffers.

Application

A useful feature which should be mentioned, as it is not obvious, is that of writing quick programs for say industrial control or demonstration use. In this application a small amount of say static RAM can be located at E000. The on-board EPROM can be switched out (by executing an output to Port FF), to permit the RAM to appear at E000. A program can be written and debugged in the E000 RAM, and when it is correct it can be "blown" into an EPROM. It is then a simple matter to replace the ZYMON 2 EPROM with that EPROM so that the user's program will run the instant the machine is switched on.

CONTENTS OF KIT

The kit of components, which is sold separately to the p.c.b. itself includes 13 resistors, 11 capacitors, 1 transistor, 1 4.0 MHz crystal, 1 push switch, 17 integrated circuit sockets and 16 integrated circuits (ZYMON 2 is sold separately). A 1" metal card front is recommended, but is not included in the kit to keep the basic cost down for those working to limited budgets.